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Wilmot, N. (1994) Renewable Energy Promotion Program in W A: Transfer of renewable energy Remote Area Power Supply (RAPS) systems to rural Western Australia. In: National Conference on Technology Transfer in Remote Communities, Murdoch University, 6 - 7 April, Perth, Western Australia, pp 74-77.

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Renewable Energy Promotion Program in WA: Transfer of renewable energy Remote Area Power Supply (RAPS) systems to rural Western Australia

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Introduction

At present there are several power sources which are suitable for the provision of power to remote communities. They include the diesel motor driven generator and various renewable energy sources and equipment. This paper discusses both the various characteristics of these systems and worldwide prospects including:

The effect of various international initiatives such as "Power for the World"(Palz 1993) on the cost of photovoltaics.

The effect of these international programs on the future for PV systems.

How they will ultimately effect Remote Area Power Supplies(RAPS).

The use of display RAPS systems set up by the Commonwealth Department of Primary Industries and Energy's(DPIE) Renewable Energy Promotion Program(REPP) to transfer this technology to remote communities Australia wide will also be presented. The West Australian display located at Murdoch University Energy Research Institute will be described.

Background.

There is a worldwide need for economical power systems in areas which are not connected to a main electrical grid distribution network. In many countries, including Australia, the cost of grid connection to remote areas cannot be justified. In some areas the choices for the population are limited to the burning of bio†matter to provide basic energy requirements for heating and cooking. They are not able to have the services which electricity brings, such as lighting, refrigeration and communications. The provision of electricity via various rural electrification schemes is seen as a necessary link in the development of those areas and their economies. In Australia, a typical solution to this problem is the use of a stand alone diesel or petrol engine/generating set to provide power as required. Another solution is the use of alternative energy systems, some using the sun or wind as their primary energy source. For approximately 50 remote Aboriginal communities basic needs are met by a system called the `Solar Pack' (James & Williams 1988). This is a transportable system housed in a shipping container and powered by a photovoltaic array. This is a RAPS system which provides 24 hour power to provide a community with basic services such as refrigeration, lighting, power for radio communications and a 240Vac power outlet for small appliances and battery charging. This is a system which is designed to meet the needs of the communal living style of Aboriginal communities.

Remote area power can at present be supplied by engine driven generators or hybrid systems which use a combination of energy sources. The most appropriate solution for any particular situation is dependent on many factors. Some of the factors include: the load size, the initial cost, is fuel available and at what cost, what was previously used, what the "neighbour" uses and what is required.

There are several problems associated with the use of diesel/petrol generating systems. Fossil fuels are a finite resource which will eventually be depleted. They have a detrimental effect on the environment due to the pollution they cause. These are not the only problems, there is also the cost of fuel, including the transportation cost to remote areas, the cost of engine maintenance, noise pollution, the need for an operator and the impracticality of 24 hour operation in single households. These are some of the reasons why alternative sources of energy, such as solar and wind energy, may be considered as possible solutions.

The sun is a source of energy which is ever present and reliable. The wind is also a source of low cost energy where site conditions are suitable. With the use of present hybrid system technology it can provide grid quality power for the remote household 24 hours a day. The technology required is modular, and it can be used for small or large scale systems. There are no problems with the supply and cost of fuels, as useful energy is derived directly from sunlight or wind. These conversion processes use photovoltaic(PV) modules (for sunlight to electrical energy) and wind turbines (for wind to electrical energy). The level of maintenance required for these systems is often negligible, and involves no more than keeping the PV modules clean, the batteries "topped up" and regular checks of the wind turbine.

At present, although renewable energy technology is technically viable, the initial capital cost of this equipment is comparatively high. People know what to expect when they need to replace or purchase a diesel generating set. It is a familiar technology with known parameters and known expectations. The ongoing costs of maintenance and fuel should be quantified and included in any economic analysis as in many situations, including the Aboriginal community, these costs are included as part of general costs for the community. An example of this is where the use of fuel for the vehicles is the same as that used for the generating plant. The initial cost of a renewable energy system includes a high level of new infrastructure: the panels and/or wind turbine/s, controllers for the solar array and wind turbine, batteries for energy storage, power conversion equipment and new wiring for the DC components of the system. As there is no fuel cost for a renewable power supply, the ongoing costs are limited to the replacement of system components. The use of Australian Standards is recommended when analysing the costs of various energy systems. If lifecycle costing is used according to AS3595-1990 the typical life expectancy of 20 years for photovoltaic modules can be the basis of any analysis. Then a replacement strategy can be used for components such as batteries which have substantially shorter life cycles.

A proposed program titled "Power for the World" (Palz 1993) by the European Commission, which is looking at providing survival power to 1.5 million villages, using photovoltaic technology will have major effects on PV manufacture. This program is based on survival energy needs which include water, health and communication needs, plus lighting, developmental and basic needs. To implement this program in one generation, for the 1 billion people, 10GW of photovoltaics are required. The effect of increasing production will reduce the cost to an estimated $US3 per watt and will benefit not only the world's poor but other areas where photovoltaics can be used such as in remote communities. In the USA the PV industry, utilities, state and federal government have formed an alliance called PV-COMPACT. They have formulated several proposals, one being aimed at driving down system cost by achieving greater economies of manufacturing scale along with developing a sustainable PV market (Weinberg 1993). Such initiatives will affect the initial capital cost of renewable power systems making it more competitive with current diesel generator technology.

At present, renewable energy technology can be justified as a solution where power requirements are small. As power requirements increase a combination of diesel and renewable technologies is more appropriate. In Esperance, Western Australia, the recent installation of the 2 mega watt Wind farm at 10 Mile Lagoon is an example of renewable energy being connected to a very large diesel power station and being a cost effective solution (Hartley 1993). In future, when the cost of photovoltaics is reduced they will also provide the solutions to the larger remote communities power needs, and other areas will also benefit.

The DPIE displays.

In order for people to realistically participate in the use of new technology there is a requirement for extensive information exchange prior to any selection of technical options (Walker 1988). The Commonwealth Department for Primary Industries And Energy (DPIE) has contracted MUERI to provide a Remote Area Power Supply (RAPS) advisory and information service for West Australians in rural and remote areas as part of the Renewable Energy Promotion Program(REPP). By the instigation of this service and display, and similar displays Australia wide, the REPP project aims to break down perceived barriers to the use of renewable energy RAPS equipment. It will also provide the information required by people before they purchase and use a RAPS system. The various displays will show that there are many benefits in the use of this renewable energy RAPS technology for remote households and Aboriginal communities. It is hoped these quality displays will counter any previous negative examples of poorly designed, older systems and equipment which have been widely publicised via the "Bush Telegraph".

The RAPS display at MUERI is open to the public. Visitors to the display will see a range of RAPS components used in the conversion of renewable energy into usable electricity. These display systems will demonstrate the compatibility of RAPS systems and electrical consumer goods. Visitors will also be able to monitor the effect of various household appliances (loads) being used on the systems. A range of RAPS equipment is displayed with several examples of each component type. The display provides information about RAPS, other available components or equipment and associated technologies.

The two basic systems on display relate to differing levels of energy use and/or style of living:

System One: *Low Energy user.*
Energy Usages: efficient dc lighting, a television, small refrigerator, radio, DC pump and other small kitchen appliances (not kettles or frypans etc).
Sizing information:

Daily Energy use:	1200 W.hr
Array size:	300 W
System Voltage:	24 V
Battery Bank Capacity:	200 A.hr(two days storage @50% D.O.D)
Inverter Rating:	2400kVA, Modified Squarewave
Wind Turbine:	300W 24Vdc 3-bladed downwind horizontal axis

System Two: *House with Basic Energy needs.*
Energy Usages: a refrigerator, efficient lighting, a home computer, a television and VCR, a stereo, microwave, pressure pump, various power tools and kitchen appliances, a washing machine and an evaporative cooler.
Sizing information

Daily Energy use:	4500 W.hr
Array size:	1200 W
System Voltage:	48 V
Battery Bank Capacity:	400 A.hr(two days storage @50% D.O.D)
Inverter Rating:	2 kW, Sinewave
Wind Turbine:	1.8 kW 48Vac 3phase 3bladed upwind horizontal axis

Energy efficient appliances were chosen for the display, and where possible, appliances typically found in every household were included. Passive solar design features are included in the building. The display entrance faces north, with two glass sliding doors and a brick-paved pergola area. The pergola is shaded with a aluminium sun control sheeting oriented to provide maximum shading in summer and maximum sunlight into the building during winter. The Building uses a concrete slab to aid in heating and cooling using passive solar design principles.

Australia Wide Displays
As part of the REPP, it is expected there will also be several household RAPS systems in at least four regions of Western Australia: in the Pilbara region, the Kimberly region, the Central and North-West region, and the Eastern Goldfields region. These are "real life" installations, where home-owners have received a subsidy from the REPP towards the system cost. As a condition of the subsidy people in surrounding areas will be able to visit the home on an appointment basis. This will allow the visitor to meet and ask questions of the people who live in the home and have experienced the benefits of switching to renewable energy systems.

Throughout Australia there is a variety of displays demonstrating Renewable Energy RAPS systems. Some are similar to MUERI's display, others are based on existing households which have been converted to using renewable energy. In the Northern Territory at the Djilkminggan Aboriginal Community 125 km south-west of Katherine their existing hybrid solar/battery/diesel system has been expanded to 15.12 kilowatts of solar panels, with the installation of 144x60 watt (8.64 kilowatts) of solar panels, to put a greater emphasis on solar power rather than diesel power (Dreyfus & Michels 1994). All of these displays have been funded by DPIE as part of the REPP program.

Conclusion

Of the present technologies suitable for RAPS systems, the fossil fuel driven generator system will eventually be replaced by systems powered by alternative sources of energy. If worldwide initiatives are successful in the reduction of PV module costs, the PV systems will be the preferred energy source. Communities which presently are looking at alternatives for power needs will be able to use PV technologies. The initiative by the Commonwealth government to provide displays of this technology Australia-wide is of value to all communities as an educational tool and an indication of the present uses of this technology and factors affecting its use. The display centre at MUERI has not been officially opened as yet, however it is attracting visitors from various places and has been well received in all instances.

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